LOCATOR STUD AND METHOD OF ASSEMBLY

FIELD OF THE INVENTION

[00001] This invention relates to a locator stud or pin for attachment to a panel which may be utilized to accurately attach other elements to the panel and the method of attaching a locator stud to a panel.

BACKGROUND OF THE INVENTION

[00002] Locator studs or pins are now used in mass production applications to accurately locate one component relative to a second component. Generally, the assembly includes a plurality of locator studs attached to a panel, such as a frame member, to accurately locate a component relative to the frame member. As an example, locator studs or pins are utilized for alignment of the control arms to the struts of a vehicle used to mount the ball joints which support the vehicle wheels. There are numerous other examples of the use of locator studs or pins in mass production applications.

[00003] As will be understood by those skilled in this art, the locator studs must be accurately positioned on the panel. Locator studs or pins include a shank or pin portion which projects from the panel and are used to locate a second component relative to the panel. The locator studs or pins, therefore, must not only be accurately located on the panel, but the shank portion must project perpendicular to the panel. It would also be desirable to attach the locator pins or studs to the panel in a mass production application without requiring welding, threading or other secondary operations. Finally, the locator stud must be firmly attached to the panel to prevent cocking or movement of the locator stud during final assembly.

[00004] The locator stud and method of assembling a locator stud to a panel of this invention achieve the advantages set forth above and the locator stud of this invention may be easily installed in a panel, for example, in a conventional die press or c-frame press. Other advantages and meritorious features of the locator stud and method of attaching the locator stud to a panel of this invention will be more fully understood from the following description of the preferred embodiments, the appended claims and the drawings, a brief description of which follows.

SUMMARY OF THE INVENTION

[00005] The locator stud of this invention includes a body portion having a radial flange portion including an annular end face and an axial generally conical recess opening through the annular end face having a major diameter at the annular end face. The locator stud further includes a generally cylindrical shank portion integral with and extending axially from the radial flange portion of the body portion coaxially aligned with the generally conical recess preferably having a diameter less than the radial flange of the body portion. In a preferred embodiment, the radial flange portion includes a frustoconical surface extending radially outwardly from the annular end face forming a lead-in during assembly of the locator stud in a panel. Further, a preferred embodiment of the radial flange portion includes a plurality of circumferentially spaced radial projections preventing rotation of the locator stud in a panel. In the disclosed embodiment, the radial flange portion has a polygonal surface adjacent the frustoconical outer surface and the radial projections extend from the corner portions of the polygonal surface.

[00006] The method of installing or attaching the locator stud of this invention includes forming a configured opening through the panel. In one preferred

embodiment, the configured opening through the panel includes a first cylindrical portion and a second frustoconical portion, wherein the frustoconical portion has a minor diameter at the cylindrical portion and the cylindrical portion has a diameter less than the radial portion of the locator stud. The method of this invention includes aligning the radial flange portion of the locator stud opposite the configured opening through the panel and driving the radial flange portion into the panel opening, wherein the radial projections are driven into the panel and prevent rotation of the locator stud in the panel. Where the configured opening through the panel includes a cylindrical portion, as described, the radial flange portion is driven into the cylindrical opening. Finally, the method of this invention includes driving a die member having a diameter greater than the minor diameter of the generally conical recess into the recess, deforming the end of the locator stud adjacent the annular end face radially outwardly, fully seating the locator stud in the panel. In one preferred embodiment, the die member includes a hemispherical end face forming an interference fit with the generally conical recess.

[00007] The locator stud and method of assembly of this invention forms a secure assembly with the shank portion of the locator stud extending perpendicular to the panel and the locator stud is firmly attached to the panel to prevent cocking or movement of the locator stud during assembly of a second component to the panel. Other advantages and meritorious features of this invention will be more fully understood from the following description of the preferred embodiments, the appended claims and the drawings, a brief description of which follows.

BRIEF DESCRIPTION OF THE DRAWINGS

[00008] Figure 1 is a side view of a panel having three locator pins or studs attached to the panel;

[00009] Figure 2 is an exploded perspective view of one embodiment of an apparatus utilized to install a locator stud in a panel;

[00010] Figure 3 is a side cross-sectional view of a panel having an opening formed therein to receive the locator stud of this invention;

[00011] Figure 4 is an end perspective view of one embodiment of the locator stud of this invention;

[00012] Figure 5 is a side cross-sectional view of the assembly illustrated in Figure 2 during installation of the embodiment of the locator stud shown in Figure 4;

[00013] Figure 6 is a side cross-sectional view similar to Figure 5 illustrating a further step in the method of this invention;

[00014] Figure 7 is a side cross-sectional view of the assembly shown in Figures 5 and 6 upon completion of the installation;

[00015] Figure 8 is a side cross-sectional view of the embodiment of the locator stud illustrated in the prior figures following installation in a panel; and

[00016] Figure 9 is a top view of the locator stud and panel assembly shown in Figure 8.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[00017] Figure 1 illustrates three locator studs 20 installed in a panel 22. As used herein, the term "panel" may be any metal plate-like member or component, such as a bracket, frame member or the like. As described above, a locator assembly

generally includes a plurality of locator studs or pins 20 as shown in Figure 1, but may also include only one locator stud 20 mounted in a panel. The locator studs each include a shank portion 24 which projects from the panel, preferably perpendicular to the plane of the panel 22, each having a frustoconical end portion 26. Each of the locator studs 20 further includes a radial flange portion 28 which is secured to the panel 22 as described below.

[00018] As best illustrated in Figure 4, the radial flange portion 28 includes an annular end face 30 and a conical recess 32 having a planar end wall 34 best shown in Figure 5, wherein the conical or frustoconical recess 32 extends into the shank portion of the locator stud 20. The outer surface of the radial flange portion 28 includes a polygonal surface 36 comprised of a plurality of planar faces 38 also shown in the top view of Figure 9. In the disclosed embodiment, the polygonal surface 36 is generally hexagonal including six planar faces 38, but the polygonal surface 36 may comprise any number of planar faces. The polygonal surface 36 in the disclosed embodiment includes a plurality of circumferentially spaced radial projections 40 each having generally radial planar side faces 42 and a generally circumferential planar end face 44. The radial projections 40 prevent rotation of the locator stud 20 following installation in a panel as described below. Finally, the radial flange portion 28 includes a frustoconical outer surface 46 which is inclined radially outwardly from the annular end face 30 to the polygonal surface 36 providing a lead-in surface during installation of the locator stud 20 as described below.

[00019] The first step in one preferred embodiment of the method of attaching a locator stud to a panel of this invention, is forming an opening 48 in the panel configured to receive the radial flange portion 28 of the locator stud 20 as best shown in Figure 3. In this embodiment, the opening 48 through the panel 22 includes

a first cylindrical opening 50 and a frustoconical opening 52, wherein the minor diameter of the frustoconical opening 52 is equal to and adjacent the internal diameter of the generally cylindrical opening 50. As will be understood by those skilled in this art, the configured opening 48 may be formed by a cylindrical punch having an outer diameter equal to the cylindrical opening 50, which will result in a frustoconical breakout opening 52 which is equal to approximately two-thirds of the axial length of the opening 48. The configured opening 48 provides additional advantages in the method of this invention as will be understood from the following description.

[00020] The next step in the method of this invention is to locate the radial flange portion 28 in the configured opening 48 through the panel 22 as shown in Figures 4, 5 and 6. First, the locator stud is oriented opposite the opening 48 with the radial flange portion 28 opposite the first cylindrical opening 50 as shown in Figure 2. In this disclosed embodiment, the method of this invention is specifically adapted for installation in a die press (not shown), wherein a plunger 54 is located in the upper die member and a die member or die button 56 is located in the lower die member; however, the orientation may also be reversed. The plunger 54 includes an annular end face 58 and a cylindrical opening 60 configured to receive the cylindrical shank portion 24 as shown in Figures 5 and 6. Further, the cylindrical opening 60 has an axial length measured from the annular end face 58 greater than the axial length of the cylindrical shank 24 as shown in Figure 6.

[00021] The next step in the method of attaching a locator stud in a panel of this invention is driving the radial flange portion 28 into the configured opening 48 in the panel 22 as illustrated in Figures 5 and 6. As shown in Figure 5, the minor diameter of the frustoconical surface 46 is generally equal to or smaller than the internal diameter of the first cylindrical opening 50 and the frustoconical surface

provides a lead-in or guide surface for the radial flange portion 28 as the radial flange is driven into the panel opening 48. The die member 56 supports the panel 22 as the annular end face 58 of the plunger 54 is driven against the annular surface 62 surrounding the shank portion 24, driving the radial projections 40 into the panel 22 surrounding the first cylindrical opening 50 as shown in Figure 6. As also shown in Figure 6, the frustoconical opening 52 has a major diameter greater than the frustoconical surface 46 of the radial flange portion 28, such that the outer surface of the radial flange portion adjacent the annular end face 30 is not fully seated in the panel as shown in Figure 6.

[00022] The final step in the method of attaching the locator stud 20 to a panel 22 is to deform the end portion of the radial flange 28 surrounding the annular end face 30 radially outwardly to fully seat the radial flange portion 28 in the configured opening 48 in the panel 22 as shown in Figure 7. As shown in Figures 5, 6 and 7, the die member 56 includes an axial cylindrical plunger 64 which reciprocates through an axial opening 66 in the die member 56. As will be understood by those skilled in this art, the die plunger 64 may be caused to reciprocate upwardly as the die press is closed, such that the locator stud is fully secured to the panel 22 with each stroke of the die press (not shown). In this embodiment, the die plunger 64 has a generally hemispherical end portion 68 which is driven into the conical or frustoconical recess 32 upon closing of the die press, deforming the end portion of the radial flange 28 radially outwardly and fully seating the locator stud in the panel 22 as shown in Figure 7. Alternatively, the die plunger 64 may be formed integrally with the die member 56, wherein the hemispherical end portion 68 projects from the end face 72 of the die member 56. In the disclosed embodiment of the apparatus, the hemispherical end portion 68 includes a slot 70 providing pressure relief.

[00023] The final locator stud and panel assembly is illustrated in Figures 8 and 9. As best shown in Figure 9, the generally radial side faces 42 of the radial projections 40 prevent rotation of the locator stud 20 in the panel 22. The annular surface 62 surrounding the shank portion 24 and top of the flange portion 28 are seated flush in the panel 22 as shown in Figure 8, which is an important feature of a locator stud or pin of this type. The radial flange portion 28 is fully seated in the panel, and the shank portion 24 extends perpendicular to the plane of the panel.

[00024] As will be understood by those skilled in this art, various modifications may be made to the locator stud and method of attaching a locator stud to a panel of this invention within the purview of the appended claims. For example, the shank portion 24 may have any suitable configuration depending upon the application. The shank portion 24 may also be externally threaded. The polygonal surface 36 may have any number of sides or may be round, wherein the radial projections 40 may be equally circumferentially spaced, rather than extending from the corner portions of the polygonal surface. The conical recess 32 may also be hemispherical, although a generally frustoconical recess is more easily formed. Finally, the shape of the end portion 68 of the die plunger 64 will depend upon the shape of the recess 32, wherein the end of the die plunger forms an interference fit with the recess and deforms the end of the radial flange portion 28 adjacent the annular end face 30 radially outwardly to fully seat the radial flange portion 28 in the frustoconical opening 52 as described above or the end portion 68 may also be integral with die member 56 described above.